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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/732,931	12/11/2003	Hong-Gun Kim	5649-1224	7254

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EXAMINER	
GEORGE, PATRICIA ANN	
ART UNIT	PAPER NUMBER
1765	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/03/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/732,931	KIM ET AL.	
	Examiner	Art Unit	
	Patricia A. George	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 March 2007*.

2a)☐ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *4-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *4-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination

A request for continued examination, was filed in this application after final rejection. Applicant's submission filed on 3/02/2007 has been entered.

Claim Rejections - 35 USC § 103

Claims 4, 9, 10, 11, 12, 15 and 16 rejected under 103(a) as being unpatentable over Knorr et al. of USPN 6,531,377 in view of Chen et al. of USPN 6,265,269.

Knorr et al. disclosed a method for providing isolation by depositing anisotropic (ab.) insulative materials between high aspect ratio trenches (col.2, l.43-54).
In figures 2-7 Knorr illustrates forming isolation trenches (111). Knorr illustrates depositing a hard mask layer (114/122) over the substrate (112), using a photo/etch process (col.4, l.3-9), which is written on forming the gap in the substrate through a hard mask thereon prior to forming the first material in the gap, as in claim 4, 11, and 12; and forming a pattern to define a gap on a substrate, as in claims 9 –11; Knorr teaches the hard mask is removed after the insulative fill material is produced and polished by CMP (col.6, l. 7-10), as in claims 11 and 12. After forming the trench in the substrate, Knorr deposits a sidewall oxide (121); an upper surface of the pattern and sidewalls of the gap comprising silicon nitride liner (125) (i.e. a non-oxide layer), which is discussed in col. 4, para. 2-3; Knorr forms a bottom oxide layer on a surface of the substrate substantially filling the gap and etching back the bottom oxide layer inside an opening in the gap to expose side walls of the gap so that a residual bottom oxide layer

remains at a bottom of the gap and teaches the preferred material for the first insulative layer at the bottom of the gap is an oxide, which illustrates selectively growing the layer (Col.4, line 27), as in claim 9; the first material further comprises avoiding forming the first material on the side wall nearer the opening in the gap, shown in figure 8; and conformably depositing a silicon nitride layer liner on a surface of the substrate including on the side walls of the gap, as in claim 10. Knorr illustrates depositing a top layer such as 130 of figure 7, 230 of figure 9, or 326 of figure 11, and teaches use of an anisotropic HDP-CVD process for one to four (see claims 1-3) insulative fill materials (co.5, para.5), which illustrates selectively depositing a top oxide layer on the residual bottom oxide layer, as in claims 9 and 16.

Although the reference of Knorr does not explicitly state the HDP oxide selectively growing on the residual bottom oxide layer faster than on the non-oxide layer, it would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of trench fill, as Knorr et al., to include that is it known that the deposition method of HDP will encompass such a selective growth, because HDP oxide deposited in the trench will intrinsically be more selective to the horizontal surfaces and therefore grow at a faster rate on the bottom oxide than the sidewall non-oxide layer creating a deposition profile which is controlled by the sputter to deposition rate. Further, absent of unexpected results, it would be obvious to one of ordinary skill in the art at the time of invention was made, to make adjustments to the s/d rate to achieve any desired profile, including applicants claimed profile.

Knorr discloses an aspect ratio of 3:1 or greater (col.6, l.40), which encompasses the claimed range of the gap depth at least about eight times greater than a width of the gap, as in claim 7.

As to claims 15, Knorr obviousness the first insulating material (116) in a thickness of approximately 300 nanometers, which converts to 3000 angstroms, encompassed by the claimed range of between about 100 Angstroms and about 3600 Angstroms.

Knorr failed to teach the bottom oxide layer "only" at a bottom gap, as in claim 16.

Chen et al. illustrates a bottom insulative oxide layer, only at bottom of gap on front page drawing, and discussion in abstract.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of providing isolation by depositing anisotropic (ab.) insulative materials between high aspect ratio trenches, as Knorr, by forming the bottom insulative layer only at bottom of the gap, as Chen et al., because Chen et al. teaches forming the lower oxide provide an insulation, which is known to prevent spiking effects (see section *Brief Summary*).

Claim Rejections - 35 USC § 103

Claims 6, 8, 13, and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Knorr and Chen, as applied to claims 4, 9, 10, 11, 12, 15 and 16 above, further in view of Yao of USPN 5,716,890, evidenced by USPN 6,177,698.

Knorr teaches insulative films through HDP CVD processing, does not explicitly teach the use of ozone activated TEOS or the process parameters that might be selected for TEOS deposition, as in claims 6, 8, 13, and 14.

As for claims 6, 8, 13, and 14, Yao teaches a method for fabricating an interlayer, insulating film, which includes HDP CVD deposition that uses ozone (col.4, l.57-60) in a range between 3500 to 6000 sccm (col.4, l.65), which demonstrates "a method wherein the rate of the first rate is about four times greater than the second rate", as evidenced by column 2, lines 54-59, of USPN 6,177,698. Yao teaches a process pressure in a range between about 400 torr and 600 torr (col.4, l.67) which is encompassed by the claimed range of 200 torr and about 760 torr, as in claim 13; introducing a TEOS to the environment at a rate in a range between about 200 and 4000 mg/min (col.5, l.1-2) as in claim 8; at a temperature in a range between about 360.degree. C. to 440.degree. C. which is encompassed and overlaps the claimed range of 400.degree. C. to 480.degree. C. as in claim 13. Yao does not use the same unit of measurement when teaching the amounts of TEOS and ozone, but Yao teaches very broad ranges for both materials, which appears to overlap a concentration of ozone between 1% and 18% by weight, as in claim 8 and 14.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to specify the method of forming ozonized TEOS, of Yao, in the invention which discloses a method for high aspect ratio gap filling using HDP-CVD, of Knorr, because Yao teaches an improved structure and process for forming a layer that

can fill narrow trenches, provide planar surfaces, have low stress, and good moisture resistance, which improves the reliability of semiconductor devices.

Claim Rejections - 35 USC § 103

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Knorr and and Chen, as applied to claims 4, 9, 10, 11, 12, 15 and 16 above, further in view of Hung et al. of USPN 6,190,999.

Knorr failed to teach a method of removing the hard mask from the substrate prior to forming the first material in the gap.

Hung et al. teaches an improved method of STI formation, which includes removing the hard mask from the substrate prior to forming the first material in the gap. See figures 2A through C and column 3, lines 25-30.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modified the invention which discloses a method for high aspect ratio gap filling using HDP-CVD, of Knorr, to remove the hard mask before depositing a trench fill, as in Hung, because Hung teaches the an improvement that increases the filling performance and prevents defects and improves adhesion of the subsequent layers which will reduce overall manufacturing cost.

Response to Arguments

Applicants' assert, on page 5, applicants' specification define recitation of "selective growing", in page 7, lines 13-22. Examiner appreciate applicants' assertion.

Applicants' make a general assertion, on page 5, that the HDP-CVD in the prior art is not selective. Examiner disagree. For the high deposition rates required in HDP a significant amount of ion bombandment must occur, creating a mode of deposition which puts the film on and takes it of at the same time. HDP is known to be usefull because the sputtering rate is dependent on the angle of incidence for incoming species. HDP oxide from high density plasmas, using RF bias, and low temperatures are known to be selective, because as the angle varies the deposition rate and sputtering rates vary. It is intrinsic to the process that films will grow most rapidly on the surfaces which are nearly horizontal, which would create a hilling effect in the trench, or applicants' claimed limitation of selectivity to the floor material, versus the wall material. Note the reference in the conclusion below.

Conclusion

Dobins (High Density Plasma Deposition of SiO2; http://www.enigmatic-consulting.com/semiconductor_processing/CVD_Fundamentals/films/HDP_SiO2.html), pvides evidence that is it known that the deposition method of HDP will provide oxide films that will grow most rapidly on the surfaces which are nearly horizontal, therefore, in the case of Knorr the oxide deposited in the trench with intrinsically be more selective toward the center of the trench (i.e. the bottom oxide layer) than the sidewalls (i.e. non-oxide layer) (see page 2, row two and three of the table presented by Dobkin). Dobkin's teaching provides evidence that any HDP deposition in a trench will be selective to the

center of the trench, vs the sidewalls, and that the method of HDP encompass the deposition growth more selective to any nearly horizontal surfaces.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patricia A. George whose telephone number is (571) 272-5955. The examiner can normally be reached on Tues. - Sat. between 8:00 am and 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Patricia A George
Examiner
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PAG
03/07

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